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TYPE E BOTULISM DUE TO SALMON EGGS
C. E. Dolman, G. E. Darby and R. F. Lane

UNIVERSITY OF MICHIGAN

THE EFFICACY OF TETANUS TOXOID
G. W. O. Moss, G. G. Waters and M. H. Brown

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Canadian Journal of
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VOLUME 46 TORONTO, APRIL 1955 NUMBER 4

Type E Botulism due to Salmon Eggs*

C. E. DOLMAN, M.B., Ph.D., D.P.H., F.R.C.P., F.R.S.C.,[1]
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and
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THE recent occurrence of another outbreak of type E botulism in British Columbia merits reporting because it emphasizes that the Pacific northwest coast is one part of the world where this rare disease appears to be most prevalent; and also because of the peculiar nature of the implicated foodstuff—salmon egg "cheese", made by Indian tribal traditional methods. This instance furnishes an estimate, for the first time on record, of the approximate fatal dose of type E toxin for man, in terms of mouse lethal units. The outbreak involved three persons, one of whom died.

Clinical and Epidemiological Features

Three young Indian women (sisters) of the Bella Bella tribe fell ill at about the same time in the late autumn of 1954, with symptoms which suggested acute food poisoning, probably botulism, to the attendant physicians. (The local Indians thought otherwise and there were rumours of witchcraft and of homicidal poisoning with drugs.) The suspected vehicle was a delicacy much esteemed by the Indians and termed by them "salmon egg cheese", whose mode of preparation will be described below. This crude caviar, is usually eaten raw, mixed with other foodstuffs such as cooked potatoes.

Clinical History

Ruby H., a 26-year old married woman weighing around 180 lb. ate about

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*Based on a paper presented at the twenty-second annual Christmas meeting of the Laboratory Section, Canadian Public Health Association, Montreal, December 13 and 14, 1954.

6 tablespoonfuls of this cheese on either October 27 or 28, without apparent ill effects. Two other young women were unaffected by smaller amounts taken on the same occasion. At the evening meal on October 31, Ruby again ate 5 or 6 tablespoonfuls of the cheese. Next morning she felt ill, her main complaints being general weakness, dryness of mouth, anorexia and vomiting. Being in the first trimester of pregnancy she attached little significance to the vomiting, although it was more severe than usual on that day. Had it not been for some vaginal bleeding on November 2, it is doubtful if she would have sought medical attention. She was in hospital from November 3 to 7, when she was discharged completely recovered.

On November 2, Ruby's 27-year-old married sister Peggy H., and her 19 year-old unmarried sister Daisy S., ate an evening meal of hot boiled potatoes with some of the salmon egg cheese sent them in a bowl by Ruby. Peggy (weight around 150 lb.) had about 3 tablespoonfuls of the cheese, and Daisy (weight around 180 lb.) ate about 6 tablespoonfuls. The following morning both felt unwell. Peggy managed to get up and do some shopping, but later vomited and developed blurring of vision, ptosis and dizziness. She was admitted to hospital the same day, where she remained for two weeks under symptomatic treatment. When discharged on November 17 she was well except for poor visual accommodation. She found it very difficult to read print until about six weeks after the onset of illness, when this symptom cleared.

The third sister, Daisy, was obviously very ill and stayed in bed. She began to vomit around 11 a.m. and her condition rapidly worsened. About 4.30 p.m. she was admitted to hospital with gasping respirations, dilated and unresponsive pupils and weak reflexes. Although frothing at the mouth, she complained of a dry throat. Her stomach was washed out and intravenous saline administered. About 40 minutes later she became cyanotic, collapsed and died of circulatory and respiratory paralysis at 5.30 p.m.—some 22 hours after ingesting the fish eggs. Autopsy revealed nothing unusual.

Preparation of Salmon Egg Cheese

The so-called cheese had been prepared by an Indian woman early in October, i.e. about four weeks before the outbreak, while she was smoking salmon to lay by for winter food. The method involves taking the salmon roe from the fish before the eggs have loosened up, as they do just before spawning begins. Plenty of fat is present at this time and the mass readily coheres into a solid lump. It is put in a clean gunny sack and left in a running stream of fresh water to wash out blood and other adventitious material. The eggs turn white overnight and are then spread out in the smoke house for some 12 hours so that they become permeated by the heat and smoke. They are then gathered into a mass which is crushed in the hands or pounded to express fluid from the eggs—thus causing the mass to "jell"—and filled into large wooden containers for storage. The mass rises owing to gas formation, but overflow is averted by poking holes into it with a stick to encourage the gas to escape. After about two weeks of storage the cheese is usually ready to eat, as judged by its being no longer gummy or sticking to the teeth. Thereafter, it maturates and may be

kept for several months. If it goes mouldy, the affected portion is cut off and discarded, the remainder being still considered edible.

This particular batch was first put into a 25 lb. wooden butter box, and when "cured" was transferred to 5 lb. honey tins, two of which were given to Ruby. A week or so later she took a fairly large serving of the cheese from one of these tins and ate it with impunity. After three or four days, she again took a similar amount from the same tin, and also scooped out a bowlful to send down to her sisters, with the results described above. The other tin was not broached.

Laboratory Tests

Various samples were shipped to Vancouver with a request for complete laboratory examination. As the clinical and epidemiological evidence pointing to botulism was soon confirmed by demonstrating type E toxin in the salmon egg cheese, no chemical analyses were conducted. Instead, efforts were concentrated upon toxicity estimations and attempts to isolate *Cl. botulinum*.

Methods

The toxicity of specimens was titrated in terms of minimal lethal doses or LD/50's for mice per gram of test material. Carefully weighed amounts (1–2 gm.) of the salmon egg samples were emulsified by means of a glass rod in a measured volume (usually 5 or 10 ml.) of physiological saline. Suspensions were left in the refrigerator for several hours to facilitate extraction of toxin from the larger undispensable particles, and were then centrifuged until clear. Appropriate dilutions of the supernatant were injected intraperitoneally into white mice. In preliminary titrations, from one to three mice received each dilution, while for more accurate estimations each dosage was tested on at least five mice. Most of the deaths occurred within a period of from 5 to 20 hours after the administration of toxic material; but fatalities delayed even for three or four days were included if preceded by the weakness of limbs, indrawn abdomen, and bellows respiration characteristic of murine botulism.

The cultural procedures comprised direct inoculation of human blood agar and Difco brain heart agar plates with a loopful of the centrifuged deposit from stomach contents and salmon egg emulsions. Also, 1–2 gm. amounts of the untreated samples were inoculated into large tubes of 1% peptone beef infusion medium containing added ground meat and 2% dextrose. To reduce complications due to the presence of many non-sporulating micro-organisms, some of the inoculated tubes were heated to 90°C. for 3 to 5 minutes, and others to 60°C. for 15 to 20 minutes. However, this comparatively slight exposure to heat apparently destroyed some *Cl. botulinum* type E spores, because on the whole unheated cultures yielded a higher proportion of successful isolations. All cultures were incubated anaerobically in a McIntosh-Fildes jar at 37°C. Thereafter, isolation and identification procedures were as described in previous reports (1, 2).

Results

Post-mortem stomach contents

This sample was 35 ml. of a dark brown fluid with finely divided matter in suspension. It had a sweet-sour odour, a pH of 6.6, and proved non-toxic for

mice in amounts up to 0.5 ml. Presumably the patient's vomiting and the stomach washing in hospital had removed all detectable toxin. However, a stained smear of the centrifuged deposit showed a few Gram-positive rods and cocci; while from about 1 ml. of the unheated suspension a toxigenic strain of *Cl. botulinum* type E was isolated. The strain was quite typical in its main cultural features, being non-proteolytic and a heavy gas producer, and yielding around 1,000–3,000 mouse M.L.D. of toxin per ml. after 4 to 6 days' incubation at 37°C. in the ground meat medium. In the same medium, considerable toxin (up to 300 mouse M.L.D. per ml.) was produced at 30°C. and almost as much at room temperature (23°C.). From the same sample, another strain was isolated which apparently resembled the foregoing one in all particulars except in being non-toxigenic.

Salmon egg cheese

The findings on three different specimens were as follows:

1. A 50 gm. sample from the previously unopened tin. This was a moist but very tacky mass of golden-brown salmon eggs, of highly fishy odour. A saline emulsion (pH 8.1) contained the equivalent of about 40 mouse M.L.D. per gram of eggs. However, as type E antitoxin failed to neutralize the lethal effect, this was probably due to infection with one or more species of micro-organisms, whose presence in large variety and numbers was demonstrated both in stained smears of the centrifuged deposit and by cultural methods. Several attempts to isolate a toxigenic strain of *Cl. botulinum* from this sample were unsuccessful.

2. About 40 gm. of material (as eaten by Ruby) taken from the other tin, which had been left open. This sample was dried out, dark brown in colour, almost covered with greenish mould and smelt musty. Titrations of its saline emulsion (pH 7.1) showed the presence of roughly 5,000–10,000 mouse M.L.D. of type E toxin per gram of eggs. A stained smear of the deposit showed a heavy mixture of various micro-organisms, including many Gram-positive bacilli, some of which had oval spores. From this specimen a toxigenic type E strain was isolated, indistinguishable from that derived from the stomach contents.

3. About 15 gm. of a remnant from the bowlful consumed by Peggy and Daisy. It was tenacious, brownish in colour, and of penetratingly fishy but not putrescent odour. A stained smear showed a few Gram-positive diplococci and numerous Gram-positive bacilli without spores.

Since the amounts of this material ingested by the two sisters were known, its toxin content was determined with special precision, in order to procure a fairly close estimate of the actual lethal dose of type E toxin. On various occasions, emulsions made from separate portions of about 1 gm. each were tested on mice, and finally the whole remainder was emulsified and titrated. The results indicated little fluctuation in toxicity within this relatively small sample, and the average of all computations was approximately 6,000 LD/50's per gram. A toxigenic strain of *Cl. botulinum* type E was again isolated from this specimen.

Discussion

This outbreak represents an apparently rare variant of the customary association of type E botulism with uncooked fish as vehicle. The only other

recorded implication of salmon eggs in human botulism also involved Indians of north-western Canada (3). Unfortunately, in that episode (which occurred in 1940 in the southern Yukon, near the British Columbia boundary) no specimens were available for laboratory examination. In both these instances, the mode of preparation and storage of the salmon eggs were highly conducive to various kinds of bacterial contamination, and particularly to botulinum toxin production. Possibly other cases of botulism of similar origin have been missed in these regions. In any event, there is obviously a need for education to discourage consumption of so excellent a culture medium as is provided for toxigenic anaerobes by a glutinous mass of uncooked "preserved" salmon eggs.

The absence of botulism caused by fish eggs in other countries where such foodstuffs are relished, may be due to failure to recognize the disease, to paucity of botulism spores in the regional soils and waters, to more sanitary methods of handling the eggs, or to some combination of these factors. In Japan, for example, salmon eggs are widely esteemed as a delicacy, being occasionally served fairly fresh in cold seasons, although usually salted and preserved. As yet no botulism has been traced to them, although no fewer than seven type E outbreaks due to some form of fish "izushi"—small pressed rice cakes containing yeast, diced vegetables and fish—have been recognized in that country in the past four years. Here is clearly no lack of botulinum spores: indeed Iida and his associates have isolated numerous type E strains from mud near Lake Abashiri, and from sand on the shores of the Sea of Okhotsk (4).

The mode of preparation of the eggs in Japan is unlikely to be as unhygienic as the methods used by our Indians; but salting alone, although no doubt somewhat inhibitory to toxin production, cannot guarantee safety. The failure to identify botulism of any kind in Japan before 1951 suggests that unrecognized outbreaks due to salmon eggs may have occurred there in the past, and that physicians and public health authorities in that country should be on the alert for future occurrences.

Also noteworthy is the absence from the available Russian literature of references to botulism due to sturgeon eggs or caviar, despite the large amounts of this foodstuff eaten in and exported from the Soviet Union. In that global area, botulinic fish poisoning has been prevalent for many years; and of course the prototype E strains originated in the U.S.S.R. Perhaps the contamination of fish eggs with botulinum spores involves an even more fortuitous mechanism than has been postulated for the pathogenesis of the commoner forms of fish-borne botulism (2). According to that hypothesis, in the majority of such instances, spores ingested by the fish germinate post-mortem, the bacilli then migrating through the gut wall into the fish muscles, and producing toxin in due course if conditions are favourable. Fish eggs may usually be harvested so promptly, or washed so thoroughly, that this mode of contamination seldom has a chance to occur. In the Bella Bella episode, the source of the type E spores must remain conjectural: it could have been from the sea from which the salmon was migrating, or the running stream in which the eggs were washed. Alternatively, the egg mass could have been polluted later with adjacent soil, either directly, or via the butter box, the stick, or dirty hands.

An important feature of this outbreak is the information it provided with

respect to the lethal dose of type E toxin for man. Reckoning an average tablespoonful of salmon eggs as 15 grams in weight, Peggy ate about 45 gm. and Daisy about 90 gm. of the cheese at the fatal meal. Since a remnant of the cheese as consumed by them showed a type E toxin content of approximately 6,000 LD/50's per gram, Peggy recovered from a dose of toxin representing roughly 250,000 mouse M.L.D., while Daisy was killed by the equivalent of around 500,000 mouse M.L.D. The amount of toxin which finally made Ruby ill (due allowance being made for some degree of desiccation of the sample tested) was probably somewhat less than that which proved fatal to Daisy. Her freedom from ill effects on the earlier occasion was presumably due to the top layers of material in the tin having been relatively toxin-free. The deeper layers could well have been more toxic because of the greater degree of anaerobiosis and the continuing production of toxin as the intervening days passed.

These figures are considerably higher than might have been anticipated from the generally low potencies, in terms of mouse lethal effects, of the toxins produced in laboratory media by type E strains. This finding has a significant bearing on the incidence and fatality rate of type E botulism, which will be discussed elsewhere. An objection might be raised to the calculated doses on the grounds that previous exposure to similar toxic foodstuffs could have induced some degree of immunity. However, this point may be countered by reference to the inefficiency of oral immunization in general, and by citing a reported recurrence of type B botulism in the same individual (5).

Finally, this outbreak, in conjunction with the latest information from Japan (4), accentuates the peculiarities of distribution of type E botulism, to which attention has been previously drawn (2). The north-west Pacific region of this continent apparently shares with northern Japan (and perhaps with parts of the U.S.S.R.) the dubious distinction of harbouring especially heavy disseminations of type E spores in their regional soils and waters. The seven known Japanese outbreaks of type E botulism have involved a total of 39 persons, of whom 11, or 28 per cent died. The four proven type E outbreaks in British Columbia have affected a total of 9 persons, with 6 deaths, a case fatality rate of 67 per cent. If the Alaskan beluga outbreak be added to the latter group, the respective totals become 5 outbreaks, 14 persons affected, 6 deaths, and a case fatality rate of 43 per cent.

Summary

1. An outbreak of human botulism occurred at Bella Bella, B.C., early in November, 1954. Three Indian sisters were affected, one fatally.

2. The incriminated foodstuff was salmon egg cheese, made by a tribal method that involves washing and smoking the mass of eggs, which are then allowed to mature in boxes or tins for 2 to 4 weeks before consumption.

3. A strain of *Clostridium botulinum* type E was isolated from the stomach contents of the fatal case, and also from samples of the salmon eggs consumed by the victims. Its toxigenic capacity in laboratory media resembled that of other type E strains, cultures attaining a potency of 1000–3000 mouse M.L.D. per ml.

4. The circumstances of this episode permitted the lethal dose of type E toxin for man to be fairly accurately determined at around 500,000 mouse M.L.D.

5. In the period 1944–1954 there have been four type E botulism outbreaks in British Columbia, all due to uncooked or insufficiently cooked fish or fish products. Of the 9 persons affected, 6 died.

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Valuable technical assistance was rendered by Miss M. Tomsich.

REFERENCES

1. Dolman, C. E., Chang, H., Kerr, D. E., and Shearer, A. R., Canad. J. Pub. Health, 1950, *41*, 215.
2. Dolman, C. E., and Chang, H., Canad. J. Pub. Health, 1953, *44*, 231.
3. Dolman, C. E., Canad. J. Pub. Health, 1943, *34*, 97.
4. Iida, H., Hokkaido Institute of Public Health, Japan. Personal communication.
5. Schwartz, J., Champy, N., and Müller, J., Strasbourg Méd., 1953, *4*, 355.

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The Efficacy of Tetanus Toxoid

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M. H. BROWN, O.B.E., M.D., B.Sc.(MED.), D.P.H., F.C.C.P.
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THE part played by tetanus toxoid in the control of tetanus as evidenced by war-time experience is well known. From an incidence of 8 per 1,000 wounded before the days of either tetanus antitoxin or toxoid, through World War I with an incidence of about 1 per 1,000 when tetanus antitoxin alone was used, the incidence during World War II fell to less than 0.1 per 1,000 wounded as a result of active immunization with tetanus toxoid either alone or with the addition of prophylactic antiserum at the time of injury. The reader is referred to the comprehensive works of Boyd (1) and Long and Sartwell (2) for a complete description. Boyd (1) points out that no deaths occurred in those who had received the prescribed course of tetanus toxoid of the British Army, two initial doses plus two or more annual boosting doses.

Beginning shortly after the start of World War II active immunization in the Canadian Armed Forces was carried out with T.A.B.T. (tetanus toxoid with typhoid and paratyphoid vaccines). A recruit received three monthly injections as the initial course. Thereafter an annual booster or recall dose was laid down as a requirement. At the time of wounding or injury the individual was to be given a booster dose of tetanus toxoid. Only three cases of tetanus were reported in the total Canadian forces during the whole war, one in an inadequately immunized individual (3).

With the cessation of hostilities, the above advice was extended to civilian practice. If an individual was injured it was recommended that the attending physician or emergency department of a hospital ascertain whether or not that individual had been actively immunized against tetanus. It was taken for granted that an ex-serviceman had at least received an initial course of immunization and accordingly it was possible to administer a recall dose of tetanus toxoid rather than to give a dose of tetanus antitoxin with its attendant discomfort or even serious complications in sensitized individuals.

However, considerable time has now elapsed since many of these men have had any stimulus to their immunity. Many were discharged eight or more years ago. Are we justified in relying on a booster dose at the time of injury after such a lapse of time? It is with the idea of answering this question that the following study has been carried out.

Moreover, in Canada since the war tetanus toxoid has found wide application either alone or in combination with diphtheria toxoid and pertussis vaccine as a measure of protecting children against tetanus. Through the

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efforts of practising physicians and public health personnel, a great proportion of the younger generation (up to the age of eight) has been immunized against tetanus with one of the above-mentioned agents and these children should be handled similarly at the time of injury.

Procedure

Through the cooperation of the medical service of a large industrial establishment, it was possible to obtain 100 ex-servicemen as volunteers. These were selected purely on the basis of answers to two questions. Were you in the Canadian Armed Forces in the last war? Have you had any injections for tetanus (lockjaw) since your discharge? It was felt that these were the basic questions which would be asked and acted upon by a physician or emergency department. For our purposes if the answer to the first question was in the affirmative and to the second negative the individual was included in the study. The subject was then asked to complete a more detailed questionnaire in respect to his service in the Armed Forces in case we should wish to check our findings against his service record of immunization.

A venous blood sample was taken for titration to determine the basic level of tetanus immunity. Immediately afterwards the individual received 1 ml. of fluid tetanus toxoid (10 Lf's) subcutaneously in the upper arm, the amount currently recommended for a booster in case of injury. This tetanus toxoid is the standard Connaught material as distributed for general use and as prepared on a suitable media so that it is free of any A factor. Seven days later the subject returned and a second venous blood sample was taken for titration for tetanus antitoxin to see if there was any increase over the basic level.

Titrations were carried out by the standard mouse test method.

Observations

In Table I the minimal interval since the individual's last inoculation is shown. It was felt desirable to determine the interval in relation to the date of discharge from the services. This is a practical point for one who has to make a decision as to the use of tetanus toxoid at the time of injury. We have the subject's statement that he has not had an injection since the date of his discharge. In times of emergency one cannot undertake to check for an immunization history and must rely on such voluntary information.

TABLE I

Tetanus Toxoid
Study Group (total 100)
Minimal Interval Since Last Inoculation

Interval (years) since last inoculation	Number Individuals
6	1
7	1
8	38
9	51
10	6
11	1
13	1
15	1

However, in selecting this point it must be kept in mind that it is a conservative date as the subject had probably not had any tetanus immunization for some time previously to his discharge. It was not given as a part of the discharge ritual. According to standard practice however the individual should have received a booster dose some time in the year before his discharge.

It is seen in our sample of 100 that the majority had been discharged from the services eight or nine years previous to this study. It should also be pointed out here that in the case of the last three individuals the interval is dated from their last inoculation. The reason for this is shown in Table II.

TABLE II

DURATION AND DEGREE OF TETANUS IMMUNITY

TIME INTERVAL (YEARS)	TITRES										TOTALS
	< .01	> .01 < .1	.1	> .1 < 1	1	> 1 < 3	3	> 3 < 10	10	> 10	
6				1							1
7				1							1
8		12	1	19	1	4	1				38
9		18		26		5	1			1	51
10		6									6
11	1										1
13	1										1
15	1										1
TOTALS	3	36	1	47	1	9	2			1	100

Titres expressed in terms of units of tetanus antitoxin per ml. of serum.

Table II shows the *level* of basic immunity in relation to the minimal interval since the last inoculation. Three individuals had less than 0.01 units of tetanus antitoxin per ml. of serum and these three have the longest intervals since their last service inoculation. On checking these three service records, it was found all were Navy personnel who received basic immunization at shore establishments early in the war. The basic series consisted only of two doses of T.A.B.T., and there was no record of booster doses. This would not be considered adequate immunization in the light of present day knowledge.

Including these three one finds that 40% of the group as a whole have 0.1 unit of tetanus antitoxin per ml. of serum or less. If one considers this by year intervals one finds 32% of the eight year group, 35.5% of the nine year group and all of the ten year group are 0.1 unit or less.

Table III shows the response in seven days to the reinforcing dose in relation to the basic immunity. This table only includes 94 cases. As inevitably happens because of absenteeism due to minor illness, etc., it was not possible to obtain the second blood sample from the other 6 on the seventh day. It is to be noted that all responded extremely well and that on the seventh day there is no one with 0.1 unit of tetanus antitoxin per ml. of serum or less.

Table IIIa records the responses of the 6 individuals whose response was measured on a day other than the seventh. The results are in line with the rest of the study group.

TABLE III

TETANUS ANTITOXIN TITRATIONS BEFORE AND SEVEN DAYS AFTER A REINFORCING DOSE (1 ML.) OF FLUID TETANUS TOXOID

	BEFORE										TOTALS
	<.01	>.01<.1	.1	>.1<1	1	>1<3	3	>3<10	10	>10	
<.01											
>.01<.1											
.1											
>.1<1	2	1									3
1		1									1
>1<3	1	4									5
3											
>3<10		10		6		2					18
10											
>10		17	1	39	1	6	2			1	67
TOTALS	3	33	1	45	1	8	2			1	94

Titres expressed in terms of units of tetanus antitoxin per ml. of serum.

Reactions to the tetanus toxoid were carefully watched for. There was no time lost from work by any member of the group. There were no general reactions. There were a number of instances of red arms but in no case did this redness exceed an area of 3 inches in diameter (most were 1½ inches in diameter). Of 23 cases of red arms, 13 occurred within 48 hours; the remainder developed on the fourth to sixth day and exhibited a dull red area of discoloration, without induration but which was quite itchy. None of the arms were troublesome enough to interfere with one's occupational activities.

DISCUSSION

Do these results answer our original question as to the effect of a booster dose of tetanus toxoid at the time of injury after a considerable lapse of time (years) from a previous stimulus? Several points need to be taken into consideration.

What is the level of immunity which affords protection against tetanus?

The infrequency of tetanus following the prophylactic use of 1,500 units A.T.S. would suggest that the level thus obtained would be satisfactory. It has

TABLE IIIA

TETANUS ANTITOXIN TITRATIONS BEFORE AND AFTER A REINFORCING DOSE (1 ML.) OF FLUID TETANUS TOXOID

Number Titrations	Interval in Days	Before	After
1	6	>.01 <.1	>3 <10
94	7	See Table III	
		>.01 <.1	>1 <3
3	8	>.01 <.1	>10
		>.1 <1	>10
1	9	>.1 <1	>10
1	10	>1 <3	>10

Titres expressed in terms of units of tetanus antitoxin per ml. of serum.

been found that 0.1 units is detectable in 24 hours; up to 0.5 units has been detected in one week; after that there was recorded a steady exponential loss (5, 6, 7). Opinions differ as to what is the minimal protective level. The figures most commonly expressed are in the range of 0.01 to 0.1 units of antitoxin per cubic centimeter of blood serum (8) although less than 0.01 units have even been considered sufficient (9).

It will be seen from our study (Table II) that 3% were below 0.01 units of tetanus antitoxin per ml. of serum, 40%, 0.1 units or less. Therefore one might conclude that a high level of protection was retained by these individuals from their war-time inoculations.

What is the incubation period of tetanus?

A review of standard texts together with certain articles of recent experience (10, 7, 4, 1) reveals a wide spread from 1 to 90 days, the usual range being 5 to 12 days. The average for one group (10) was 8.4 days but the average for the fatal cases in the group was 5.7 days. The use of A.T.S. (when given in insufficient amounts) prolonged the interval, most cases occurring after 30 days. Cases occurring in the actively-immunized during World War II exhibited a shorter incubation period, under 10 days (7, 1). However, it bears repeating here (1, 3), no deaths occurred in the British Army or in the Canadian Army overseas in those who had received the prescribed course of tetanus toxoid.

Will the response to a reinforcing dose of tetanus toxoid occur in time to prevent tetanus?

The first measurable increase of tetanus antitoxin following the administration of a reinforcing dose of tetanus toxoid has been known to occur on the 3rd day (8). However, in the majority of instances it begins about the 5th day, reaching a peak in 10 to 14 days (12, 11, 8). Wishart (13) working with diphtheria toxoid records the earliest definite increase as occurring on the 4th day, with a 100% response by the 7th day.

It will be seen from our study (Table III) that all responded by the seventh day to a level more than sufficient to protect against tetanus. Moreover in most instances individuals had a basic immunity sufficient to protect against tetanus.

Although this study was not designed to demonstrate the point, there would appear to be no indication from these results that with an increasing lapse of time there is a delaying effect on the response to the reinforcing dose as concluded by Miller (4) with alum-precipitated toxoid. One would expect such degrees of response (up to a thousand fold) to have begun occurring some days before the date of sampling on the 7th day.

Summary

Tetanus antitoxin titrations were carried out on 100 Canadian ex-servicemen who had not had booster doses of tetanus toxoid since some time before their discharge from the services eight or more years previously. The men while in the services had been immunized according to service routine with T.A.B.T. vaccine. Ninety-seven showed a titre of greater than one one-hundredth of a

unit and sixty-one a titre of one-tenth of a unit or greater. A titre of 0.01 to 0.1 units antitoxin per c.c. blood serum is generally accepted as sufficient to afford protection against tetanus.

The antitoxin response to a 1 ml. dose of fluid tetanus toxoid (10 Lf's) was measured on the seventh day in 94 instances and on the sixth to tenth day in the remaining 6 instances. All 100 responded to a level of greater than one-tenth of a unit of antitoxin. Seventy-one had a level greater than ten units.

The incubation period of tetanus varies widely depending on whether the individual is non immune or has received tetanus antitoxin at the time of injury or was actively immunized at some date in the past. One might consider 10 days a reasonable average. A rapid response to a booster dose in our group occurred within 7 days. This would be ample time to afford protection against all but a fulminating infection in which event even prophylactic tetanus antitoxin might not be successful.

None of the participants in the study experienced any significant reactions to the tetanus toxoid.

However, with the passage of time it is not possible to predict how long this ability to respond to tetanus toxoid will remain. The opportunity should be taken of giving booster doses of tetanus toxoid to ex-servicemen employed in industry at the present time rather than postponing it to some uncertain time in the future on the occurrence of an injury. Thereafter a booster dose once every five years would seem sufficient.

Conclusion

The administration of 1 ml. of fluid tetanus toxoid at the time of injury to personnel actively immunized as in the Canadian Armed Forces in World War II produced an early and marked increase in the antitoxin content of their blood. The resulting level of antitoxin which was produced is generally accepted as being sufficient to protect against clinical tetanus.

A lapse of eight or more years since the last preceding stimulus to the active immunity does not appear to adversely influence the response to the booster dose.

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REFERENCES

1. Boyd, J. S. K.: Lancet, 1946, *250*: 113.
2. Long, A. P. and Sartwell, P. E.: Bull. U.S. Army Med. Dept., 1947, *7*: 371.
3. Feasby, W. R.: Official History of the Canadian Medical Services, 1939–45. Vol. 2.
4. Miller, J. J. et al.: Pediatrics, 1949, *3*: 64.
5. Bigler, J. A. and Werner, M.: J.A.M.A., 1941, *116*: 2355.
6. Sneath, P. A. T.: Canad. Pub. Health J., 1934, *25*: 195.
7. Sachs, A.: Proc. Roy. Soc. Med., 1952 *45*: 641.
8. Bigler, J. A.: Am. J. Dis. Child., 1951, *81*: 226.
9. Cooke, J. V. and Jones, F. G.: J.A.M.A., 1943, *121*: 1201.
10. Diaz-Revira, R. S. et al.: J.A.M.A., 1948, *138*: 191.
11. Boyd, J. S. K. and MacLennan, J. D.: Lancet, 1942, *243*: 745.
12. Banton, H. J. and Miller, P. A.: New England J. Med., 1949, *240*: 13.
13. Wishart, F. O. et al.: Canad. J. Pub. Health, 1944, *35*: 276.

Supervision of Medical Care in a Rehabilitation Program

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WHEN considering any medical care plan, one must look first at the eventual objective and outcome of the plan, as it applies to the patient himself. If this is done, one realizes at once that medical care must be considered only as part of a full picture of returning the individual to a respected and productive member of society. To this whole process is given the term "rehabilitation". One must be most careful not to restrict the use of this word to what, in the writer's opinion, is only a part of rehabilitation; that is, the actual placement of an injured person in some job. Often terms are used too freely, and this is one example.

Rehabilitation—The Objective of Medical Care

Rehabilitation must mean all aspects and all facilities used to assist in the treatment, financial support, job placement and resettlement of the patient.

Perhaps the Ontario Workmen's Compensation Board should be called the Workmen's Rehabilitation Board, and dispel the idea that the function is merely to pay compensation for injury. Perhaps the departments could be described better by saying that the aims could be divided roughly into three types of rehabilitation: (1) medical rehabilitation, (2) financial rehabilitation, and (3) industrial rehabilitation (vocational training and placement). To these might be added a fourth—resettlement, a consideration of home environment.

Any integrated scheme must consider all of these, as they are of equal importance for success. To treat a patient, while his family is destitute, is as bad and as unlikely of success as to amputate a leg and then tell the man, "Go get a job, we have done our part." Cooperation cannot be expected from the man if outside worries are his constant bedfellow. Yet, without co-operation, schemes for full treatment and other aspects of rehabilitation are not likely to be very successful.

Rehabilitation is a team effort, and the patient is the most important member of the team. His cooperation is of the utmost importance, and without it there will be no success.

Individual Assessment and Rehabilitation Planning

At the outset, a rehabilitation program requires a primary assessment of

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the problem. First a physical assessment must be made to ascertain the physical limitations of the patient, extent of disability, and most important: "Can anything be done to reduce or eliminate this disability?"

Here great care must be used to see that the recommendations are economic and reasonable. Too often cases of extensive surgery are seen, the outcome of which is dubious and the final result, if successful, leaving a reduction of disability disproportionate to the loss of time to the patient, and unnecessary cost to the financing organization. Indeed cases are known of psychological or even psychiatric breakdowns from extensive surgery where the final result would not justify the means taken. In any civilian scheme dealing with many serious medical conditions of great crippling force such as cerebral palsy and rheumatoid arthritis, etc., this is going to be a terrific problem, but yet one of utmost importance.

The goal must be plotted and the course charted with the risks and advantages weighed before the sail is set.

Similarly, the industrial possibilities and opportunities must be considered at an early stage. Psychological testing, aptitude testing, age, ability and desires must be considered, as well as whether or not there is a probability of a job when training is completed. An early start on this phase will save much lost time and later expense, but of far greater importance, it will elevate the patient's morale. He sees a goal ahead, something to work for, instead of the blank worry of a cold uncertain future.

Financial Support

During all this time, the man will require some form of financial support. Few in the class requiring rehabilitation have the means to carry them and their families through any prolonged period of lack of income.

The Workmen's Compensation Board of Ontario is very fortunate in having an Act which allowed the building up of an organization which can cover all three fields. The medical department is responsible for the first aspect—medical rehabilitation; the claims department for the second—financial (in addition to their other duties); and what is termed the Rehabilitation Department for the third and also to help in the resettlement problems. Indeed by an amendment to the Act, they also have funds available for financial assistance when this cannot be charged off as compensation payments in the usual manner.

Remembering that this concept of rehabilitation is the objective of our supervision of medical care, let us consider some of the problems of quality control of medical care.

Medical Care Supervision

Before considering the necessities of a system of quality control of medical treatment, certain matters in the philosophy of handling people should be mentioned. In a system, such as used by the Workmen's Compensation Board, the co-operation of the medical profession is not only desired but essential. Ontario is a widespread province, with many isolated or semi-isolated communities. Often the local doctor is the only medical attendant available.

The problem, then, is to gain that co-operation and still carry out the task of supervision; that is, to insist on the moving or alteration of treatment, even though this may cast some degree of doubt on the ability of the doctor, and yet retain his co-operation.

To do this it is necessary to view the situation from both sides, from the doctor's and from the Board's.

The Doctor's Viewpoint

A doctor by education and his work in the community holds a very responsible and respected position. Also, although he may not be the most suitable one to treat some particular injury, he may be most efficient and skilful in handling most of the problems he encounters in his practice. Again, it may be lack of opportunity to obtain experience and skill or lack of facilities rather than lack of ability, which is his handicap.

Noting these three points, it will be seen that consideration must be given to: (1) the effect on the doctor, and (2) the effect on the doctor's community. The doctor cannot be made a part of the rehabilitation team if there is constant friction between the supervising organization and the local medical attendant. It is essential to keep the doctor posted on policy in treatment, so that he is not embarrassed by sudden unexpected instructions, when he has already told the patient his course of action.

Remembering that large organizations, inherently, have an authoritative power in the minds of the uninitiated, the supervising organization must not set up one doctor in a small community over others of equal qualifications. It is better to move the patient right out of the community than to have local referral, unless the profession itself has established the pattern of such referrals.

For example, in a community with four general practitioners, local referral is unwise. People might say, "Well the Board feels that Dr. X. is better, and they should know", without realizing that in most things Dr. X. is no better than Dr. Y. The latter's position may be jeopardized, and his feelings toward the Board can be well imagined.

In a second community of like size, one doctor may hold a specialist qualification in surgery. Here the profession has already established a reason and local referral will do no harm.

These are examples of the importance of the type of philosophy needed to handle the situation competently. Many more could be added. Dictatorial methods do not suffice. They are out-of-date and will not bring the needed co-operation.

Lessons from the Board's Experience

Recently a doctor in a small isolated community, with minimal hospital facilities, performed an open reduction of a fracture of the medial malleolus without the authority of the Workmen's Compensation Board or indeed without the latter knowing of the case. The reduction was incomplete and the screw nail not fully inserted. Later the skin sloughed and the fracture became infected. A comparatively routine operation ended as a complicated procedure involving skin coverage and bone infection.

Good medical care is expensive but not nearly so costly as poor or inadequate attention.

As a basis of medical care administration in the realm of supervision, although obvious, it is not always remembered that we are not all equally adept at diagnosis, assessment, and surgery. Not only is a high degree of skill required in treatment, but also experience and practice, and good facilities. That practice makes perfect is true, given an equal ability at the start. The doctor or surgeon who sees a type of case only once every three or four years is not likely to apply as efficient treatment as the man who sees it weekly. In dealing with some 4,000 doctors who do compensation work in Ontario, this is most evident. Therefore, it seems advisable to have some method of quality control of treatment.

Before quality control can be instituted, however, certain requirements apply. (1) The necessary authority must be present. (2) A reasonably workable method of control must be set up. (3) Some standards should be available and recognized.

Authority for Control is vested in the Board by the Workmen's Compensation Act, sec. 50 (6) of which states that "All questions as to the necessity, character and sufficiency of any medical aid furnished or to be furnished and as to payment for medical aid shall be determined by the Board." This at once clears the air, because it implies that the Board is merely doing its job. Indeed if the Board did not exercise some control, it could be considered negligent. When the Act says the Board 'shall be', it implies that the Board would not be carrying out its mandate if it did not do so. Also it establishes definitely in the minds of all that in the final analysis the Board legally can and will direct the course of the treatment. This is an important psychological factor.

A workable method of control. Here the background should be mentioned. First, it is not usual for the Board's medical officers actually to see the case at the time of the original injury; consequently other methods of assessment of quality must be developed. Secondly, no doctor can guarantee the results of treatment. Indeed our laws recognize this by stating that the doctor is only responsible for seeing that good and reasonable treatment is given; and if this is done, the patient has no legal right of action if the results fail. We all know of a case like the 20 year-old lad with a fracture, given what appeared to be excellent treatment, but which failed to unite for reasons unknown to the profession.

Two approaches to the problem are suggested: (a) direction of treatment and (b) quality control of treatment.

Direction of Treatment

The Board could consider that its duty was resolved if it merely judged the results of treatment. However, we feel that the problem should include assistance to the profession in the method of handling surgical problems, and in instruction.

For example, in hernia cases, a recent review of Board files indicated periods of hospitalization of from 4 to 22 days in apparently similar cases. Some

doctors regularly keep cases in hospital longer than other doctors, without any valid reason or improvement in results. In another case of electric shock a doctor brought methods of resuscitation to a halt, after a few minutes, when continuation might have saved a life. He apparently did not realize the importance of long-continued efforts. Similar principles apply to fractures in many cases.

The Board, by observing the work of many doctors, can perhaps arrive at a better idea of the correct procedure to produce better efficiency of treatment with no loss of quality.

Old methods of treatment must be reassessed periodically to see how they should be altered in the light of advance in professional knowledge. New methods must be carefully analysed to find if they warrant replacing the more tried procedures.

Methods considered of value in the direction of treatment would include such items as the organizing, either alone or in conjunction with professional bodies, of surgical conferences and meetings, and distribution of information either from study of our material or standard teachings which seem to have been forgotten. Recently, the Board has taken over a section of the official journal of the Ontario Medical Association for this purpose. Special papers, and advice to teaching bodies, where a lack of knowledge is discovered, are of value also.

Quality control of treatment

This comes from a terminology very familiar to industry, where it implies the production of goods which closely approximate a specified standard.

Medicine is both an art and a science. The science indicates the measurable portion of diagnosis and treatment, by the laboratory, x-ray examination, etc. The art is the unmeasurable, the part that covers the case of the patient with normal laboratory findings even though they should be abnormal. For this reason, standards can never be set up such as seen in industry, nor can results be the sole criterion. If there were a sufficiently large number of cases with each doctor, a mean might be established as a standard and used for comparison. However, it is seldom that any one doctor has a sufficient number of cases of one type for this method to be used without serious caution. Sampling analysis may be also of value, either by drawing a given number of cases treated by a doctor and comparing it to a standard, or as a random sampling method for general control. It is planned to investigate further the possibilities of this method.

Getting definite facts is an important problem. Written reports are not too complete or descriptive. Here, however, one does get an indication, which can be enlarged by telephone conversation with the treating doctor, or by letter. Occasionally, and it should occur more often, this is supplemented by visits to hospitals to check on patients and the treatment in progress.

The best method of control at the Ontario Board is the one which gives definite information. This is the x-ray film. The regulations state that no x-ray films will be paid for unless the film is forwarded to the Board's offices within a definite time after taking. These give definite facts as to treatment and the results.

All films are checked by skilled film examiners: first for errors in reporting, missed fractures, dislocations, etc., and secondly for omissions, such as the presence of arthritis, etc., which may not be recorded on the report but may have a bearing later on the progress and handling of the claim. All positive films are photographed by special apparatus to give a permanent 4 × 5 inch record, useful both for a review of the case during treatment and also as a permanent record (as many institutions cannot store films for more than five or ten years due to current volume).

Serious injuries, or errors in treatment, as recorded by the films are then passed to a surgeon for review and corrective measures, such as advice to the attending surgeon, or direction as to referral to a specialist. This is the best method of control, and fortunately, since much of the work is related to trauma, it covers a large percentage of cases.

However, a word of caution is necessary. It must be pointed out that x-rays can only reveal the condition and result of treatment of bone injury. Soft tissue injury, which can be very crippling, cannot be estimated by this method.

A final method, and probably one of the best, is a knowledge of the capabilities of the various doctors carrying out treatment. Over a period of years, and from the experience of seeing many cases both during treatment and when they come up for estimation of permanent disability, one gradually learns the abilities of doctors. In this way the doctors indicate the limitations of their own abilities, and medical officers of the Board recognize them and take appropriate action Thus, when an injury occurs the doctor knows the Board's wishes as to handling or referral. The medical profession has set up its standards of training and qualifications for specialist standing, but not necessarily for quality of work. The profession's list of specialists is accepted, but from these, Board experience removes those who do not combine good principles with skilled practice. On review of cases, inadequately or poorly executed treatment is carefully noted, and especially errors in the basic principles, such as the internal fixation of fractures without first adequately reducing the fracture. Those who do not seem skilled in carrying out treatment are refused permission to treat certain types of cases, and must either refer them elsewhere or obtain permission first. Certain difficult procedures, such as discotomy, are restricted to suitable specialist groups, by policy.

Of greater importance than any control method is the quality and experience of the staff carrying it out. Not only must they be well trained and have knowledge of their work, but also they must be of the type of individual who can 'get along' with others and handle problems in a considerate and diplomatic manner.

Merely establishing a system of control and informing the profession that it is in force (even though it may not be) will produce improvement. Each man feels his work is being checked and consequently may be more careful.

In the present scheme wherein controls are actually applied, there is a considerable tendency on the part of the doctor to carry out such methods of treatment or referral as the Board would desire. Knowing that he will be instructed as to the Board's wishes anyway, he does not wait for the inevitable. Thus many positive and desirable results of control occur without action on

the part of the Board or, of course, without being entered to the credit of the controls. Reason would indicate that the system is desirable, and the day-to-day work of the Medical Department in noting and correcting errors, that it is necessary. A steady reduction in permanent disability rates is a further indication of value and efficacy:

	No. of Permanent Disabilities	Lay-off Claims	Total Claims
1940	1432	27,245–5.25%	72,292–1.98%
1951	1775	45,010–3.94%	176,563–1.05%

Summary

The general philosophy of the scope and function of rehabilitation as considered by the Ontario Workmen's Compensation Board is briefly discussed.

The background, necessities and methods employed in quality control are indicated. A dual approach is employed, first by improving the quality of treatment by investigation and dissemination of advice through conferences, meetings, and writings, and secondly by direct control of quality by limiting the type of treatment provided by the less experienced.

Brucella Melitensis in the North West Territories

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HUMAN brucellosis is comparatively rare in Alberta. In the seven years preceding 1953 the infecting organism has been isolated from human cases in only nine instances. All these strains, within my personal knowledge and from other information (1), have been classified as *Br. abortus* on their biochemical and serological behavior. A few other cases of human infection have been diagnosed each year on serological grounds only, but until now there has been no suggestion of the occurrence of Brucella species other than abortus. It is therefore of considerable interest to find that two strains identified as *Br. melitensis* have been isolated during the past year and to discover that they came from Eskimos normally resident at Bathurst Inlet within the Arctic circle. The patients, one adult and one child, of different families, had been brought to the Charles Camsell Indian Hospital in Edmonton for treatment of tuberculosis. A clinical description of one of these two cases has already been published (2) and a report on co-existing brucellosis and tuberculosis in the other has been prepared by Corrigan and Hanson (3), but the epidemiological significance of the findings is wholly dependent on the validity of strain identification. This report describes the isolation and bacteriological investigation of these Brucella strains.

Isolation of Organisms

Bone marrow obtained from each patient, was seeded on liver agar slant (Castaneda) and incubated under 10% CO_2. In one case, No. 668, growth appeared on the eighth day. A guinea pig inoculated with the original specimen was sacrificed at six weeks and showed no evidence of infection. However, a second animal inoculated with splenic pulp from the first, developed serum agglutinins for Brucella, and when autopsied at six weeks showed gross pathological lesions, suggesting brucella infection. A culture from this animal yielded an organism which, from the characters described below, could be recognized as *Br. melitensis*. This organism was in every respect similar to the one isolated initially on liver agar. The serum from this patient, No. 668, agglutinated *Br. abortus* to a titre of 1/12800. (*Br. melitensis* antigen was not available at this time.)

In the second case, No. 347, growth appeared on liver agar on the 15th day. This organism was similar to the one referred to above. Concurrent tuberculous infection interfered with the primary guinea pig isolation, but a pig inoculated with the original culture developed agglutinins for Brucella and at autopsy the organisms were recovered from pathological lesions in the spleen, liver and testicles. The serum from patient No. 347 agglutinated *Br. abortus* to a titre of 1: 100.

Investigation

The organisms were cultured on various media but were studied chiefly on liver agar. Suspensions did not agglutinate in acriflavine and colonies appeared smooth when observed by oblique light. Immediate transplants from the original cultures grew well in 48 hours without CO_2. Lead acetate strips inserted in the culture tubes showed no evidence of H_2S production in five days.

The dye sensitivity tests were performed according to the method of Huddleson (4) who incorporated into liver agar poured plates N.A.D. dyes in appropriate concentrations. The following concentrations were used: crystal violet 1/50,000 and 1/100,000; basic fuchsin 1/25,000 and 1/50,000; thionin 1/30,000 and 1/60,000. The plates were incubated three days.

Urea tests were conducted with the medium of Rustigan and Stuart (5) with phenol red as the indicator. Equal quantities of standardized culture and medium were incubated at room temperature and observed at ten minute intervals for color change. The Carbamate test was carried out according to the technique of Renoux (6). Blotting paper disks, saturated with a solution of sodium diethyldithiocarbamate, were placed on heavily inoculated liver agar plates. The diagrammatic description of Renoux was used for the interpretation of this test.

Absorbed melitensis and abortus antisera, supplied from the Standards Laboratory (P.H. Laboratory Service, Colindale, London), were used for tube agglutination tests. The serological findings were confirmed by further tests with absorbed sera from Weybridge Veterinary Laboratory, England.

Interpretation of Results

By morphology and colonial characteristics the organisms conformed to the descriptions of Brucella species (4). Urea was alkalised in approximately 100 minutes which, following Pickett (7), accords with the abortus-melitensis pattern and excludes suis strains. Neither strain produced H_2S nor required CO_2 while both grew in the presence of thiamin and fuchsin, but only slightly in crystal violet; all points in favor of melitensis. The carbamate tests were somewhat difficult to interpret, but results conformed to the melitensis pattern as published by Renoux (6), and were completely different from control abortus strains. The serologic tests resulted in a three-fold higher titre with absorbed melitensis antisera than with abortus antisera (1/160 to 1/20—Weybridge) (1/320 to 1/80—Colindale). While it is appreciated that the differences between the species are difficult to define, it was concluded from the above evidence that the strains must be regarded as *Br. melitensis*.

Discussion

The difficulties of detecting and identifying Brucella species have not been stressed but are very real especially in circumstances where the epidemiological situation is not known. The isolation of these two strains supports the suggestion of Spink that culture methods are superior to animal inoculation, but their identification necessitated a very considerable amount of specialized work in this laboratory and consultation and help from laboratories in England and in the United States. The debatable significance of many of the recommended tests emphasized the danger of relying on any one of them and final diagnosis could be achieved only by accepting the balance of evidence from all.

In this instance the slight anomoly of the serological crossing does not have the same significance as in the new species of Brucella postulated by Renoux (8) or in the strains mentioned by Cruikshank in his review of that work.

The isolation of *Br. melitensis* is unusual in Canada and extraordinary in the Northwest Territories. Speculation about the source of infection is inevitable. Brucellosis is known to occur in cattle in this province but is believed to be due to infection with *Br. abortus*. Similarly infections have been detected in buffalo and elk in the national parks (9) and though a number of these animals were removed from the parks and released in the north some years ago this is not likely to be significant. Certainly no evidence of melitensis infection in human or animal has ever been detected in Alberta. There remains the possibility of melitensis infection having been brought to the Canadian northland by reindeer introduced from Lapland, or by its occurrence as a natural infection in muskox or caribou, animals on which the Eskimo relies to a considerable degree for his food. Since nothing is known of the nature or incidence of brucellosis in such animals their importance is conjectural. It seems probable, however, that infection in these described cases occurred through milk or direct contact with discharges. Reindeer or caribou seem the most probable reservoirs.

The incidence of such infections in our Eskimo populations is unknown. A survey on sera from 169 Eskimos hospitalized in Edmonton for tuberculosis revealed Brucella antibodies in only one case other than the two described above. However, even in areas where brucellosis is not uncommon the incidence of antibodies in the general population may be no higher. Further study of human and animal populations of the Canadian North is desirable, and the final epidemiological picture must be clarified by isolation and differentiation of Brucella strains where infections are encountered.

Summary

Two strains of *Br. melitensis* have been isolated from Eskimos in the Canadian North. Extremely careful bacteriological investigation was essential as a prelude to any future epidemiological study.

The circumstances indicate that infection from any usual source is almost impossible and suggest a possible reservoir in reindeer or caribou.

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REFERENCES

1. Shaw, R. M.: Personal communication, 1954.
2. Matas, H., and Corrigan, C.: Canad. M.A.J., 1953, *69*: 531.
3. Corrigan, C., and Hanson, S.: (Canad. M.A.J., 1955, *72*; 217.)
4. Huddleson, I. F.: Brucellosis in Man and Animals, The Commonwealth Fund, New York, 1943.
5. Rustigan, R., and Stuart, C. A.: Proc. Soc. Exper. Biol. & Med., 1941, *47*: 108.
6. Renoux, G.: Ann. Inst. Pasteur, 1952, *82*: 556.
7. Pickett, M., Nelson, E., and Liberman, J.: J. Bact., 1953, *66*, 210.
8. Renoux, G.: Ann. Inst. Pasteur, 1952, *83*: 814. Bull. Hyg., 1953, *28*: 380.
9. Moore, T.: Canad. J. Comp. Med., 1947, May: 131.

Fluoride Content of New Brunswick Water Supplies*

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DURING the last decade, since it has been shown that dental health is affected by the amount of fluoride ion in the water, civic and public health officials have taken an increasing interest in this matter. Investigations in Canada and the United States have indicated that the presence of fluoride in the water in the proportion of 1.0 to 1.2 parts per million (p.p.m.) has a beneficial effect and tends to reduce dental caries in children (4, 2). In these investigations it has been shown that it is feasible to add fluorine to public water supplies which are deficient in this element. It has been established that mottled enamel occurs when the fluoride content exceeds 1.5 p.p.m. (3).

Before any fluoridation program is undertaken, the present fluoride content of the drinking water supplies must be determined and made known.

In cooperation with the Department of Health and Social Services of the Province of New Brunswick, this laboratory undertook a survey of the fluoride content of communal water supplies during 1952–1953. In the following year, 1953–1954, in addition to continuing the study of communal supplies, the survey was extended to include representative wells of schools and of National Defence establishments. The accompanying map (Fig. 1) indicates the location of the water supplies tested, as well as the type of supply and the number of individual sources for each community.

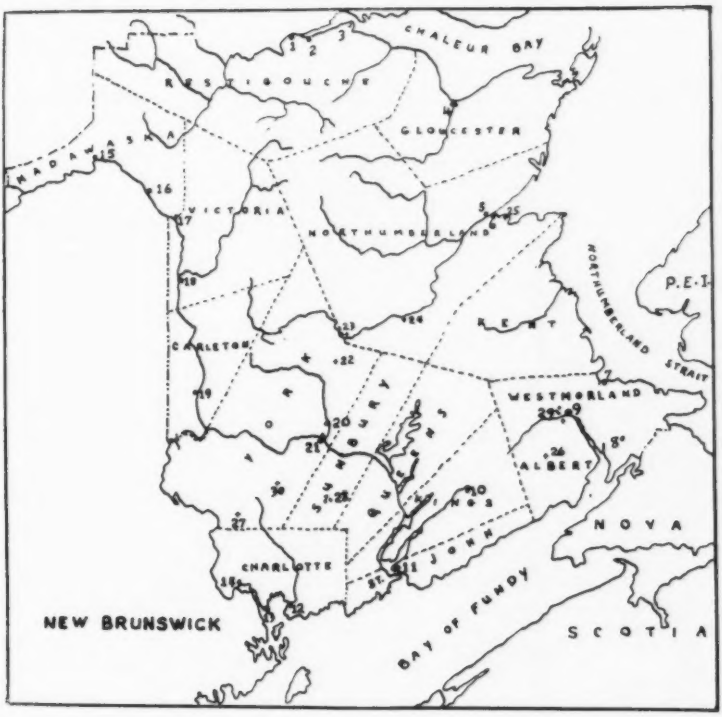
All samples were tested by two methods: "Standard Methods" (1), and a photoelectric method (5). In addition, a number of tests were made using the Helige Aqua Tester. Fifteen hundred and sixty-eight tests were performed on 689 samples during 1952–1953. In the following year 2,935 tests were done on 1,285 samples. The results for each source were averaged. These are shown on the histogram (Fig. 2). The number of samples from each source is indicated in brackets after the name of the source.

FINDINGS

The majority of waters tested have a fluoride content of less than 0.3 p.p.m.

Shediac well No. 2 has more than 0.5 p.p.m. of fluoride and is the only communal supply tested, exclusive of Coverdale Naval Station, with a significant amount of fluoride.

*This survey was made possible by a grant from the Department of National Health and Welfare and was under the supervision of Dr. C. W. Argue of the Department of Biology, The University of New Brunswick.



LEGEND

No	Place	Surface Supply	Dug, or bored well	Artesian well
1	Atholville		2	
2	Campbellton	1		
3	Dalhousie	2		
4	Bathurst	1		
5	Newcastle			3
6	Chatham		2	
7	Shediac		2	
8	Sackville			4
9	Moncton	2	7	
10	Sussex	1		
11	Saint John	2		
12	St. George		2	
13	St. Andrews	1		
14	St. Stephen			1
15	Edmundston		3	
16	St. Leonard	1		
17	Grand Falls	1		
18	Perth	1		
19	Woodstock	1	1	
20	Marysville		2	
21	Fredericton	1	2	
22	McGivney		2	
23	Boiestown		1	
24	Doaktown		1	
25	Chatham (R.C.A.F.)		2	
26	Elgin		1	
27	McAdam		1	
28	Fredericton Jct.		3	
29	Moncton Area		4	
30	Harvey		1	

Individual wells at Fredericton Junction have significant amounts of fluoride in the water, varying from 0.46 p.p.m. to 1.2 p.p.m.

A well belonging to the Harvey Creamery at Harvey Station has a high fluoride content of approximately 1.9 p.p.m.

F⁻ in ppm
Athelville, Well #1, (.32)
Athelville, Well #2, (.28)
Campbellton, (.42)
Dalhousie, Charlo Dam, (.57)
Dalhousie, McNeish Dam, (.59)
Bathurst, (.23)
Newcastle, (.37)
Chatham, Cassidy Well, (.39)
Chatham, Park Well, (.53)
Shediac, Well #1, (.45)
Shediac, Well #2, (.44)
Sackville, Well #1, (.23)
Sackville, Well #2, (.23)
Sackville, Well #3, (.23)
Sackville, Well #4, (.23)
Moncton, Irishtown Rd. Reservoir, (.57)
Moncton, McLaughlin Rd. Reservoir, (.57)
Moncton, Well #2, (.47)
Moncton, Well #3, (.45)
Moncton, Well #4, (.45)
Moncton, Well #5, (.40)
Moncton, Well #6, (.44)
Moncton, Well #7, (.44)
Moncton, Well #8, (.43
Sussex, (.63)
Saint John, Loch Lomond, (.54)
Saint John, Spruce Lake (.55)
St George, Well #1, (.30)
St George, Well #2, (.30)
St Andrews, (.61)
St Stephen, (.71)
Edmundston, (.19)
St Leonard, (.16)
Grand Falls, (.39)
Perth, (.46)
Woodstock, Saint John R., (.40)
Woodstock, Inland Park Well, (.49)
Marysville, Well #1, (.48)
Marysville, Well #2, (.48)
Fredericton, Saint John R., (.79)
Fredericton, Clark St Well, (.79)
Fredericton, St Mary's St Well, (.79)
McGivney, 32 O.A.D. PMQ, (.15)
McGivney, 32 O.A.D. Rec Hall, (.13)
Boiestown, Regional High School, (.10)
Doaktown, School, (.11)
Chatham, R.C.A.F. Station, (.10)
Elgin (Albert Co.) School, (.10)
McAdam, NBLC Store, (.11)
Fredericton Jct. Hospital, (.7)
Fredericton Jct. Service Station, (.4)
Moncton Area, Hildegarde School, (1.2)
Moncton Area, Parkton School, (1.2)
LEGEND
photoelectric method
standard method
F⁻ in ppm
Moncton Area, Parkside School, (1.2)
Moncton Area, Coverdale Naval Stn. (2.6)
Fredericton Jct., Regional High School (0.9)
Harvey, Harvey Creamery, (1.0)

FIGURE 2

In Moncton area there are individual wells containing high amounts of fluoride in the water. Parkside School well has a fluoride content of 1.36 p.p.m. Coverdale Naval Station has the highest fluoride content of any supply tested in this survey, 2.66 p.p.m. of fluoride.

REFERENCES

1. American Public Health Association: Standard Methods for the Examination of Water and Sewage, 9th ed., 1946. New York, N.Y.
2. Ast, D. B., Finn, S. B. and McCaffrey, I.: Am. J. Pub. Health, 1950, *40*: 716.
3. Dean, H. T., Arnold Jr., F. A., Jay, P. and Knutson, J. W.: Pub. Health Rep., 1950, *65*: 1403.
4. Hutton, W. L., Linscott, B. W. and Williams, D. B.: Canad. J. Pub. Health, 1951, *42*: 81.
5. Megregian, S. and Maier, F. J.: J. Am. Water Works A., 1952, *44*: 239.

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THE 1954 TRIAL OF POLIOMYELITIS VACCINE (SALK)

ON April 12, Dr. Thomas Francis Jr., presented a report from the Poliomyelitis Vaccine Evaluation Centre on the effectiveness of the poliomyelitis vaccine, prepared by Dr. Jonas E. Salk, and used in the field trial last spring.

It was an occasion that will be long remembered by all who had the privilege of attending. It was very fitting that the report was presented in the University of Michigan which joined with the National Foundation for Infantile Paralysis in presenting the findings. Dr. Salk was a member of the University of Michigan School of Public Health as a research fellow for five years, working under the direction of Dr. Thomas Francis Jr., who is one of the senior members of the staff of the University of Michigan where the work of the evaluating centre was conducted. Dr. Alan Gregg, Vice-President of the Rockefeller Foundation presided.

Dr. Salk received a standing ovation in recognition of his outstanding achievement. It was an occasion also for recognition of the leadership of Mr. Basil O'Connor who, as President of the National Foundation, pressed forward with the arrangements for the preparation of the vaccine and the planning of the nationwide trial to determine its value. Dr. Thomas Francis presented in detail a comprehensive report of the Vaccine Evaluation Centre and was enthusiastically applauded.

Dr. Thomas E. Rivers, Director of the Rockefeller Institute for Medical Research and chairman of the Vaccine Advisory Committee, and Dr. Hart E. Van Riper, Medical Director of the National Foundation spoke briefly of the field trials and their significance. The successful preparation of the vaccine by Dr. Salk is part of the large research program which has been a major function of the National Foundation from its inception.

In the planning of the extensive field trial of last spring, approximately 201,229 children received three injections of a placebo consisting of the culture fluid without poliomyelitis virus or monkey kidney protein. Observations were made on approximately 749,236 children in the first, second and third grades in the areas where the placebo control trial was undertaken. In these areas, 200,745 children received three injections of vaccine. In other areas where a

placebo was not given, the study population totalled 1,080,680 children in the first three grades and of this number 221,998 second grade children received three doses of vaccine. To permit of an evaluation, records were required for each of the 1,829,996 children in the study population.

The Poliomyelitis Vaccine Evaluation Centre was established at the University of Michigan for the purpose of impartially correlating and analysing data collected through the joint efforts of many thousands of health workers, practising physicians and others scattered through the 211 participating study areas in 44 States. The specific study areas were selected because of their consistently high incidence of poliomyelitis during the past five years. It was essential that non-vaccinated children should be studied with the same degree of care as the vaccinated so that the discovery and diagnosis of poliomyelitis in test and control groups would be strictly comparable. In order to achieve such an impartial evaluation, it was essential to introduce the placebo control study into the plan and this type of study was carried out in 88 areas in 11 States and 127 areas of 33 States. Careful study of all cases diagnosed as poliomyelitis was made.

The question of safety of the vaccine was assessed through specific studies of the cause and extent of absenteeism from school following inoculation in Pittsburgh and Schenectady, N.Y. It was found that the experience was identical in vaccinated and control groups and no significant reactions were observed. In the placebo control areas, the incidence of minor reactions was 0.4 per cent in the vaccinated and 0.4 per cent in those receiving placebo. Of the so-called "major" reactions, none of which could be clearly attributed to inoculation, 0.004% occurred in vaccinated and 0.006% in the placebo group. For the purpose of measuring the antigenic potency of the various lots of vaccine used, blood samples were collected prior to vaccination, two weeks after the third dose and again five months later from 40,881 children. Results from the study of sera from 9,000 of these were made available in time to be included in Dr. Francis' report. In general the response to Type I poliomyelitis virus was inferior to that for Types II and III. A further report will be made later when the serological studies have been completed.

In investigating all cases of poliomyelitis or suspected poliomyelitis in the study population, clinical epidemiological reports were prepared. Reports of muscle evaluation made by specially selected physiotherapists and a review of their findings together with a laboratory study of stool and blood samples from all patients was made by clinical experts.

In the report, a comparison of poliomyelitis in the vaccinated and control populations is presented through a series of steps, each one attempting to further refine the diagnosis. A total of 1,013 cases was reported in the study population with onset during the two week period following the third vaccination to December 31, 1954. The analysis of the data through the stages of refinement shows a progressive increase in the percentage of effectiveness displayed.

Dr. Frances summarized the findings of the report of the Evaluating Centre as follows: "From these data it is not possible to select a single value giving numerical expression in a complete sense to the effectiveness of vaccine as a

total experience. If the results from the "observed study" areas are employed, the vaccine could be considered to have been 60–80 per cent effective against paralytic poliomyelitis; 60 per cent against Type I poliomyelitis, and 70 to 80 per cent effective against disease caused by Types II and III. There is, however, greater confidence in the results obtained from the strictly controlled and almost identical test populations of the "placebo study" areas. On this basis it may be suggested that vaccination was 80–90 per cent effective against paralytic poliomyelitis; that it was 60 to 70 per cent effective against disease caused by Type I virus and 90 per cent or more effective against that of Type II and Type III virus. The estimate would be more secure had a larger number of cases been available."

These data show the marked effectiveness of the vaccine. It is to be noted that some cases of poliomyelitis occurred in the vaccinated group. It is unfortunate that reports in newspapers and other publications have given an impression that the vaccine was completely successful. Following further research studies the vaccine will probably be made even more effective.

At the meeting in Ann Arbor, Dr. Salk recommended a change in the basis of administration relating to the interval between doses. He stated that the first and second doses only should be given at this time, observing an interval of two to four weeks between doses. The third dose should be administered not earlier than seven months after the second dose. The effect of the third dose is comparable to that of a booster dose being followed by a rapid rise in the antibody titre to many times that which followed the primary inoculations. This recommendation was made following observations relating to children vaccinated last spring, as well as a smaller group vaccinated in 1953. Dr. Salk further suggested that the adoption of this plan of administration would make current supplies of the vaccine available to more children.

In Canada these recommendations have been adopted by several of the Provincial Departments of Health. On the revised basis, the supplies of vaccine would be sufficient for the administration of the first and second doses to approximately 1,000,000 children.

The announcement of the findings by Dr. Francis and the recognition throughout the world of the achievement of Dr. Salk, offers great promise that by active immunization the incidence of paralytic poliomyelitis may be greatly reduced and the fear of this disease dispelled.

To Dr. Salk, to Dr. Francis, to Mr. O'Connor and the members of the scientific staff of the National Foundation, Canadians express their deep gratitude.

A SHORT MORBIDITY CLASSIFICATION FOR USE IN INDUSTRY

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IN developing methods of recording and tabulating lost-time morbidity statistics for use in industry, it was found desirable to draw up a special list of causes of morbidity. It was agreed that, while this list should conform to the needs of industry, it should be short, cover the full range of the International Statistical Classification of Diseases, Injuries, and Causes of Death, W.H.O., 1948, and be so arranged that the section headings thereof could be re-constructed without difficulty.

This list, entitled *A Short Morbidity Classification for Use in Industry*, was so designed as to fit the basic framework of the International Statistical Classification and to include specifically those items which by reason of their relative frequency or special interest were important to industrial medicine. A further distinctive feature in the construction of the list is the inclusion of residual categories for each section of the International Statistical Classification.

The list was specifically designed for use in conjunction with a dual-purpose punch card system for collecting lost-time morbidity data in industry* and covers all sections but one of the International Statistical Classification; Section XV, Diseases of Early Infancy, is the one excluded.

*A Dual-Purpose Punch Card System for Collecting Lost-Time Morbidity—Brochure No. 2, prepared by the Divisions of Industrial Hygiene and Medical Statistics, Ontario Department of Health.

The categories within International Statistical Classification Section XV, Diseases of Early Infancy, are not included in this Classification because its function did not require it. Should it be desired to include data on dependents of employees, for any reason, and such morbidity information not be dealt with independently of the employee lost time records, Section XV would have to be fitted into the present Classification.

In constructing the list, three of the sixteen International Statistical Classification Sections (diseases of the respiratory system, diseases of the genito-urinary system, and accidents, poisonings and violence), were subdivided so that, even in condensed form, separate presentation of certain causes of particular interest to industry would be easily achieved. The resulting 19 headings are, for convenience, called Diagnosis Groups, and within this modified International Statistical Classification framework are the 72 independent rubrics comprising the Short Morbidity Classification.

In its final form the Classification developed is not far removed from the *Special List of 50 Causes for Tabulation of Morbidity for Social Security Purposes, W.H.O., 1948.* The two lists differ, however, in that the Short Morbidity Classification includes thirteen rubrics according to the nature of injury (N) code under the section "Accidents, Poisonings, and Violence" whereas the Special List of 50 Causes provides three broad categories according to the external cause (E) code. In addition,

it was considered necessary for the purposes of industrial morbidity statistics to identify certain disease entities not separately distinguished in the Special List of 50 Causes and these have been incorporated in the *Short Morbidity Classification for Use in Industry*.

Because industry has always used the term "sickness" to include and the term "injury" to exclude non-accidental injuries, i.e. effects of poisons, weather, exposure, and related conditions, Section XVII—Accidents, Poisonings, and Violence (Nature of Injury), was sub-divided and the following definitions set down to ensure a clear understanding of the relationship of the Classification to morbidity terms in current usage.

Disease—Those causes of morbidity included in the first 17 Diagnosis Groups (Short List Numbers 011–179 inclusive). These Groups comprise the first 16 sections of the International Statistical Classification, code numbers 001–795.

Injury—Those causes of morbidity produced by an external cause such as accident, effects of poison, weather, etc., violence or adverse reaction to medical procedure. Injuries constitute the eighteenth and nineteenth Diagnosis Groups (Short List Numbers 181–203). These Groups correspond to Section XVII of the International Statistical Classification, code numbers N800–999.

Sickness—Those causes of morbidity included in the first 18 Diagnosis Groups (Short List Numbers 011–182). These Groups comprise the disease categories including abdominal hernias (International Statistical Classification code numbers 001–795), plus non-accidental injuries, i.e. effects of poisons, weather, exposure, and related conditions, code numbers N960–989.

Accident—Those causes of morbidity contained in the nineteenth Diagnosis Group (Short List Numbers 190–203). This Group includes injuries with the exception of effects of poisons, weather, exposure, and related conditions, code numbers N800–959 plus N990–999).

This arrangement will not only allow for compilations to be made in the major grouping desired by industry ("sickness" and "accident") but will also permit, if necessary, the compilation of data in the categories "disease" and "injury".

The complete list of 72 rubrics with the corresponding Detailed International Statistical Classification Numbers, is presented in Appendix A. The numbers were so assigned to the 72 rubrics that the first two digits correspond to the two digits of the diagnosis groups in which they fit; this facilitates sorting and tabulation. For general reference purposes there is no reason why rubrics in the list might not in fact be numbered serially from 1 to 72.

The 19 Diagnosis Groups, the framework of the Short Morbidity Classification, identified by number, are shown below with the International Statistical Classification code numbers in parenthesis. The corresponding International Statistical Classification Sections together with the Short List Inclusions are also indicated.

For many purposes it is desirable to present data relating to morbidity absenteeism in industry, in even more condensed form. For this purpose a condensation comprising the following seven Condensed Diagnosis Groups has been found useful.

Although it is recommended that all morbidity absences be coded according to the Short Morbidity Classification of 72 rubrics, data prepared regarding the company's illness absenteeism will most frequently be presented according to one of these sets of "diagnosis groups". This will provide data in a standard form and will facilitate inter-plant comparisons.

Should data relating to specific causes of absence, e.g. pneumonia, fractures, etc., be of interest, it is a simple procedure to extract these data by sorting on the units column of the Short List Numbers, to obtain the specific cause counts required.

To enable comparisons both within a company over a period of time and between various companies during the same period, it is essential that some uniform and relatively simple method of classifying the causes of morbidity be available. *The Short Morbidity Classification for Industry*, comprising 72 items, now being used by many plants in Ontario was prepared with this objective in mind. Experience indicates that there is much to recommend it.

Group Numbers	Short List Inclusions	I.S.C. Section Number	Diagnosis Group
01	011–019	I	Infective and parasitic diseases (001–138)
02	021–023	II	Neoplasms (140–239)
03	031–034	III	Allergic, endocrine, metabolic and nutritional diseases (240–289)
04	041–042	IV	Diseases of the blood and blood-forming organs (290–299)
05	051–053	V	Mental, psychoneurotic and personality disorders (300–326)
06	061–064	VI	Diseases of the nervous system and sense organs (330–398)
07	071–079	VII	Diseases of the circulatory system (400–468)
08	081–084	VIII pt	Acute upper respiratory infections (470–475)
09	091–099	VIII pt	Other diseases of the respiratory system (480–527)
10	101–109	IX	Diseases of the digestive system (530–587)
11	110	X pt	Disorders of menstruation (634)
12	121–123	X pt	Other diseases of the genito-urinary system (590–637) (except 634)
13	130	XI	Deliveries and complications of pregnancy and childbirth (640–689)
14	141–142	XII	Diseases of the skin and cellular tissue (690–716)
15	151–152	XIII	Diseases of the bones and organs of movement (720–749)
16	160	XIV	Congenital malformations (750–759)
17	171–179	XVI	Symptoms, and ill-defined conditions (780–795)
18	181–182	XVII pt	Effects of poisons, weather, exposure, etc. (N960–989)
19	191–203	XVII pt	Accidents, and violence (N800–959, N990–999)

Group Numbers	Short List Inclusions	Condensed Diagnosis Group	International List Numbers Included
08	081–084	Acute upper respiratory infections	470–475
09	091–099	Other diseases of respiratory system	480–527
10	101–109	Diseases of digestive system	530–587
11	110	Disorders of menstruation	634
17	171–179	Symptoms, and ill-defined conditions	780–795
19	191–203	Accidents and violence	N800–959, N990–999
Rest	Rest	Other specified causes	Rest

APPENDIX A

A Short Morbidity Classification for Use in Industry Based on the International Statistical Classification of Diseases, Injuries, and Causes of Death

Short List Number	International Classification Numbers	Short Morbidity Classification Title
01	*001–138*	Infective and Parasitic Diseases
011	001–008	Tuberculosis of respiratory system
012	010–019	Tuberculosis, other forms
013	020–029	Syphilis and its sequelae
014	030–035	Gonococcal infection
015	045–048	Dysentery, all forms
016	050, 055, 056, 085, 089	Common infectious diseases (scarlet fever, diphtheria, whooping cough, measles, and mumps)
019	Rest	Other infective and parasitic diseases
02	*140–239*	Neoplasms
021	140–205	Malignant neoplasms
022	210–229	Benign neoplasms
023	230–239	Neoplasms, not otherwise specified

Short List Number	International Classification Numbers	Short Morbidity Classification Title
03	*240–289*	ALLERGIC, ENDOCRINE, METABOLIC AND NUTRITIONAL DISEASES
031	240–245	Allergic disorders
032	250–254	Diseases of the thyroid gland
033	260	Diabetes mellitus
034	270–289	Other metabolic, endocrine and nutritional diseases
04	*290–299*	DISEASES OF THE BLOOD AND BLOOD-FORMING ORGANS
041	290–293	Anaemias
042	294–299	Other diseases of the blood and blood-forming organs
05	*300–326*	MENTAL, PSYCHONEUROTIC AND PERSONALITY DISORDERS
051	300–309	Psychoses
052	310–318	Psychoneurotic disorders
053	320–326	Disorders of character, behaviour, and intelligence
06	*330–398*	DISEASES OF THE NERVOUS SYSTEM AND SENSE ORGANS
061	360–369	Diseases of the nerves and peripheral ganglia
062	330–357	Other diseases of the nervous system
063	370–389	Diseases of the eye
064	390–398	Diseases of the ear and mastoid process
07	*400–468*	DISEASES OF THE CIRCULATORY SYSTEM
071	400–402	Rheumatic fever and chorea
072	410–416	Chronic rheumatic heart disease
073	420–422	Arteriosclerotic and degenerative heart disease
074	440–447	Hypertensive disease
075	450–456	Diseases of the arteries
076	460–466	Diseases of the veins
079	Rest	Other diseases of the circulatory system
08	*470–475*	ACUTE UPPER RESPIRATORY INFECTIONS
081	470	Acute nasopharyngitis (coryza)
082	471	Acute sinusitis
083	472–474	Acute tonsillitis, pharyngitis, laryngitis and tracheitis
084	475	Acute upper respiratory infection, multiple or site n.o.s.
09	*480–527*	OTHER DISEASES OF RESPIRATORY SYSTEM
091	480–483	Influenza
092	490–493	Pneumonia
093	500–502	Bronchitis
094	519	Pleurisy
099	Rest	All other respiratory diseases
10	*530–587*	DISEASES OF THE DIGESTIVE SYSTEM
101	530–535	Diseases of the teeth and supporting structures
102	540–545	Diseases of the stomach and duodenum (except cancer)
103	550–553	Appendicitis
104	560–561	Hernia of abdominal cavity
105	571	Gastro-enteritis and colitis
106	584–586	Diseases of gall bladder and bile ducts
109	Rest	Other diseases of digestive system
11	*634*	DISORDERS OF MENSTRUATION
110	634	Disorders of menstruation
12	*590–637*	OTHER DISEASES OF THE GENITO/URINARY SYSTEM (except 634)
121	590–594	Nephritis and nephrosis
122	600–609	Other diseases of the urinary system
123	610–637	Diseases of the genital organs
13	*640–689*	DELIVERIES AND COMPLICATIONS OF PREGNANCY AND CHILDBIRTH
130	640–689	Deliveries and complications of pregnancy and childbirth

Short List Number	International Classification Numbers	Short Morbidity Classification Title
14	*690–716*	DISEASES OF THE SKIN AND CELLULAR TISSUE
141	690–698	Boils, cellulitis, abscesses and other skin infections
142	700–716	Other diseases of skin and subcutaneous tissue
15	*720–749*	DISEASES OF THE BONES AND ORGANS OF MOVEMENT
151	720–727	Arthritis and rheumatism, except rheumatic fever
152	730–749	Other diseases of bones and organs of movement
16	*750–759*	CONGENITAL MALFORMATIONS
160	750–759	Congenital malformations
17	*780–795*	SYMPTOMS, AND ILL-DEFINED CONDITIONS
171	791	Headache
172	790	Nervousness, debility and asthenia
179	Rest	Other symptoms and ill-defined conditions
18	*N960–989*	EFFECTS OF POISONS, WEATHER, EXPOSURE AND RELATED CONDITIONS
181	N960–979	Effects of poisons
182	N980–989	Effects of weather, exposure, and related conditions
19	*N800–999*	ACCIDENTS, VIOLENCE, AND, ADVERSE REACTIONS (except N960–989)
191	N800–829	Fractures
192	N830–839	Dislocations without fractures
193	N840–848	Sprains, strains of joints and adjacent muscles
194	N850–856	Head injury (excluding fracture of skull)
195	N860–869	Internal injury of chest, abdomen and pelvis
196	N870–908	Lacerations, open, and puncture wounds
197	N910–929	Superficial injury, abrasions, contusions, slivers, splinters
198	N930–936	Foreign body entering natural orifice
201	N940–949	Burns
202	N950–959	Injury to nerves and spinal cord
203	N990–999	Other and unspecified accidents, violence, early complications of trauma, adverse reactions due to medical procedures

Public Health Administration

THE CHALLENGE OF ACCIDENTS TO PREVENTIVE MEDICINE

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A GREAT many agencies are involved in varying degrees in accident prevention and safety teaching. Despite this considerable but rather diffuse effort, the toll of accidents continues to rise. The rapid mechanization of our age and the relative slowness with which the human element is adjusting to this mechanization is largely responsible for this mortality and morbidity.

It is hardly necessary to quote statistics to prove that accident prevention is of prime importance to the public health program. In the United States and Canada 100,000 accidental deaths occur each year. There are probably 100 non-fatal accidents to every fatal accident.

The death rates from infectious diseases have dropped so precipitously that accidents have become one of the leading causes of death. Childhood fatalities are of particular interest: (1) over one-half of the childhood accident fatalities occur before the age of five years; and (2) in the first five years of life the peak incidence of accident fatalities is in the one to two year age group, in spite of the fact that children after the age of two have increased access to the accident hazards (1).

In some fields prevention of accidents has been notably successful. In industry accident hazards have been reduced and special devices have been invented to reduce accident incidence. In no other field, however, of accident hazard has the same scientific thought been devoted to the problem. Obviously, the causes of accidents are many and frequently due to a combination of causes. Those employed in industry are usually at the optimum age, physical condition and intelligence for the avoidance of accidents. The same does not apply in the home, the farm or on the highway.

The industrialization of the farm has brought special hazards to what at one time was considered to be peaceful existence from which a long expectation of life could be anticipated. High powered salesmen each year are presenting the farmer with more and more complicated items of equipment, and in many cases his education in the use of this equipment has not kept pace with the requirements of the machine age. In no other industry are expensive and complicated machines operated by persons who have not had special training by experts in the task. Safety precautions advised by the manufacturers are generally not emphasized by the salesmen and are usually ignored by the farmer.

No attempt has been made to introduce into the design of farm equipment a recommended color code for safety. Color speaks a universal language when properly used as a visual aid to safety. Standard colors for specific purposes have been devised to identify safety equipment and accident hazards (2). High visibility orange should be used as a basic color to designate dangerous parts of equipment which may cut, crush,

shock or otherwise injure. An important use of orange is to reveal hazards when shields or guards have been removed.

Education in rural schools should contain a very much higher proportion of vocational teaching. Training in safety precautions in handling machinery should be included as a high priority in all teaching in rural areas.

Household accidents represent another field where prevention is difficult because of the variety of hazards encountered. Over-steep stairs without handrails are probably the most difficult hazard to eliminate. Good illumination is of the utmost importance and the use of scotchlite or yellow paint to highlight the edges of steps in poorly-lit areas, is a simple and probably useful measure. The use of saucepans and pots with small grip handles on both sides rather than the conventional long handle would also lend a measure of safety. Distinctive labelling of all drugs, insecticides and cleaning fluids should also be practiced.

However, the problem is again an educational one and this education should start at a very early age. Until a baby is about eighteen months complete protection from all accident hazards is needed. If he is burned, drowned, crushed, poisoned or mangled he has been denied that protection. From one year of age, protection must be replaced with education. The introduction of standards for home construction, which would apply both to rural and urban areas, in addition to sufficient authority to enforce them, should also be of value in eliminating such dangers as stairs which are too narrow and too steep. Rural electrification, producing better home lighting, and eliminating the use of inflammable materials for illumination will undoubtedly save the lives of many. Accident prevention in the home requires three tools; forethought, time and discipline. For too long we have been waiting for someone else to teach parents how best to give this education. It is time we realized that unless we do it nobody else will.

Public health nurses, family doctors, social workers and others who in the course of their daily duty enter many homes must have their thinking on accident prevention aroused. Educational materials should be made available to them for distribution where it can serve the greatest good, that is, in the home.

Far too many drowning accidents occur and it is significant that the majority of these are not associated with public bathing places. Farm dugouts are a frequent location for these tragedies. More rigid enforcement of fencing regulations would undoubtedly improve this situation. Every farmer should realize his responsibility, even to trespassers (usually of school age) and ensure that any dugouts or pools of water on his land are either safely fenced or drained adequately.

A similar situation prevails with regard to highway accidents. Severe punitive measures and traffic enforcement procedures have succeeded in reducing the number of highway accidents. Alcohol while an important factor in a number of accidents is by no means the greatest cause of highway accidents. It has served as an excuse to explain every accident which occurs on the highway. This kind of thinking is unrealistic and will never do anything to prevent the four out of five highway accidents in which alcohol has no part.

No attempt has been made to enforce the use of safety belts in automobiles, especially for those passengers sitting in the so-called suicide seat (the seat next to the driver). Only one or two motor manufacturers have made a serious attempt to make the instrument panel of soft material in order to reduce the number of head injuries of those involved in impact accidents. Only scant consideration has been given to the fact that fatigue and the visual monotony of long distance driving on modern highways is

at least as important a factor in the causation of accidents as is "debble alcohol".

The use of varying surfaces on different stretches of highway and the use of different colored pavement could easily reduce the visual and auditory monotony of long distance driving. Varying colored pavement could also be employed for approaches to danger areas, such as, railway crossings and curves.

"Cats-eyes" (self-cleansing glass reflectors embedded in a rubber pad), which are placed in the centre of the highway contribute effectively to safety on highways in many places. "Cats-eyes", while unsuitable for use in extremely cold climates, are of such considerable advantage in night driving, that despite cold winters, their use should be considered. In the field of preventive psychiatry, the development of simple tests, which would help eliminate the accident prone driver from holding a driver's license, is a challenge.

Organizations for the control and eradication of various diseases, ranging from tuberculosis to muscular dystrophy exist, that are heavily endowed by public and private funds. Yet there is no overall organization for the prevention of accidents, which now rank fourth in our leading causes of death. A voluntary organization involving the best brains in industry, manufacturers of farm and automobile equipment, highway engineers, agriculturists and experts on housing should be constituted. Those of us involved in the practice of preventive medicine have a clear duty to advance the formation of such an organization and to assist it in every way in our power.

REFERENCES

1. Dietrich, H. F.: J.A.M.A., 1954, *156*: 929.
2. National Safety Council, Chicago: Farm Safety Review, 1953, *11*, No. 4, 6.

NEWS

British Columbia

THE ANNUAL INSTITUTE for provincial public health staff was held in the Hotel Georgia, Vancouver, from April 12 to April 15. The Institute was attended by public health physicians, dentists, nurses, health educators, sanitary inspectors and clerks from health units throughout the province.

The main speaker this year was Dr. G. F. Amyot, Deputy Minister of Health and Provincial Health Officer, who spoke on "Future trends of Public Health in British Columbia", "A Program for Evaluating Health Services", and "The Health Unit as a Team."

Other presentations included an outline of the program of the Alcoholism Foundation of British Columbia; a symposium on rehabilitation; field reports from dentists, nurses and sanitary inspectors; occupational health; shigellosis, salmonellosis and infectious hepatitis; care of the handicapped child (a panel discussion); film utilization; statistics in action (recent findings in British Columbia's health statistics, some applications of statistics in British Columbia's health program and policies, some recent measure of British Columbia's health status); and a symposium on the handling of T.B. patients in the hospital and community.

In addition to the above general presentations attended by all staff, special sectional meetings were also utilized. On the first evening, April 12, the annual meeting of the Canadian Public Health Association, British Columbia Branch, was held in the Vancouver Art Gallery auditorium with Dr. Brock Chisholm as guest speaker.

Alberta

MRS. MARGUERITE MACALISTER (nee Miss M. M. Fitzsimmons) has resigned as director of public health nursing in Alberta after nine years service in public health work.

MRS. DOROTHY MCPHAIL, a graduate of the University of Alberta, has succeeded Mrs. Macalister as director of public health nursing. Mrs. Jean Wright (nee Miss Jean Campbell) has been appointed assistant director.

DR. C. E. ANDERSON has been appointed to supervise the medical aspects of the rehabilitation program of the province of Alberta. He continues as director of the Communicable Disease Division but has been relieved of responsibility for supervision of provincial health units.

MISS ELAINE CORNISH will return to the Municipal Nursing Service in August after a leave of absence to study at McGill University.

Manitoba

DR. M. R. ELLIOTT, Deputy Minister of Health, represented the Department of Health and Public Welfare at the announcement on the Salk poliomyelitis vaccine field trials made at the University of Michigan, Ann Arbor, April 15. Dr. Elliott attended the session at the invitation of the National Foundation for Infantile Paralysis, New York,

DR. C. R. DONOVAN has retired from his position as Director of Public Health Services with the Department of Health and Public Welfare.

New Brunswick

THE HONOURABLE J. F. MCINERNEY, M.D., announced the Salk poliomyelitis vaccine will be offered to residents of New Brunswick on a voluntary basis. He stated that all district Medical Officers of Health are being notified to make plans for holding clinics in their respective areas, starting in April. Actual inoculation responsibility rests with the Medical Officers of Health and public health nurses, with the Department providing the vaccine and giving essential coordination to the project. Vaccine will be available for approximately 18,000 children in the most vulnerable age groups and in the localities most affected by poliomyelitis in the past.

THE FREDERICTON CITY COUNCIL at its last regular meeting, voted in favour of fluoridating its public water supply. Dr. R. S. Langstroth, Director of Dental Health for New Brunswick, was in attendance at the meeting to answer any inquiries about fluoridation. This is the second centre in the province to have fluoridation approved by its elected representatives.

EMPLOYMENT SERVICE

Advertisements regarding "positions available" and "personnel available" will be published in from one to three consecutive issues, depending upon the requirements of the agency or person concerned. They are limited to seventy words or less, with a confidential box number if desired. There is no charge for this service to members of the Association. Health agencies are charged a flat rate of $10.00 for the advertisements (up to four consecutive issues) and for the service. The rate for non-members is $5.00. The service includes confidential clearing of information between prospective employer and employee if desired.

Public Health Nurses required by Department of Health, City of Kingston. Salary range in effect, five day week, pension and hospitalization plans available. Apply to Medical Officer of Health, City Hall, Kingston. 4–5

Sanitary Inspector, qualified, required by the Department of Health, City of Kingston. Salary range in effect, transportation provided, five day week. Pension and hospitalization plans are available. Apply to Medical Officer of Health, City Hall, Kingston, Ontario.

Public Health Nurses for generalized program. Minimum salary $2700, with allowance for previous experience and annual increments of $120. Cumulative sick leave plan. Pension plan and Blue Cross plan available. Interest free loans available for purchasing cars if necessary. Liberal transportation allowance and holidays. Apply to A. E. Thoms, M.D., Director, Leeds and Grenville Health Unit, Victoria Building, Brockville, Ontario. 4–5

District Supervisor required for City of Ottawa Health Department, preferably with certificate in Administration and Supervision in Public Health Nursing. Generalized program under Director of Public Health Nursing. Good personnel policies, Blue Cross and Pension plan available. For further details apply Employment and Labour Office, Treasury Department, Transportation Building, 48 Rideau Street, Ottawa 2, Ontario.

Assistant Director of Public Health Nursing required by City of Ottawa Health Department. Certificate in Administration and Supervision in Public Health Nursing required. Generalized program. Good personnel policies, Blue Cross and Superannuation plan available. For further details apply to Personnel Office, Transportation Building, 48 Rideau Street, Ottawa 2, Ontario.

Public Health Nurse (qualified) for City of Ottawa. Generalized program. Good salaries. Blue Cross. Superannuation. For details please apply to Personnel Officer, Labour and Registry Office, Transportation Building, 48 Rideau Street, Ottawa 2, Ontario.

Sanitary Inspector, qualified, required by the East York–Leaside Health Unit. Salary range in effect, transportation provided. Pension and hospitalization plans are available. Apply to Medical Officer of Health, East York–Leaside Health Unit, Coxwell and Mortimer Avenues, Toronto 6. 4–5

Public Health Nurses, qualified, for generalized public health nursing city service, and one for secondary school program. Basic salary $2900, adjusted according to experience on starting. Annual increment $150. Shared pension, medical care and hospitalization plans. Sick leave accumulative. Transportation provided or car allowance. Apply to Medical Officer of Health, Peterborough, Ontario. 4–5

Sanitary Inspector required for generalized program in health unit. Excellent working conditions, pension plan, Blue Cross and P.S.I. available. Car allowance. Write to Dr. Charlotte M. Horner, Medical Officer of Health, Northumberland-Durham Health Unit, Cobourg, Ontario. 4–7

Staff Nurses required for Kent County Board of Health Unit. Policies are 38 hour week, three weeks holiday with pay, all statutory holidays, two days a month sick leave accumulative to 48 days. Uniforms provided. Minimum salary $2700, plus annual increments as determined by the Board, to a maximum of $3100. 4–5

Public Health Nurse with experience, preferably trained in Ontario. Good personnel policies, car provided, in-service training related to treatment and care of orthopaedic patients. Apply, stating age, to Supervisor of Nursing, Ontario Society for Crippled Children, 92 College Street, Toronto, Ontario. 4–7

Sanitary Inspector, qualified, bilingual, required by Prescott and Russell Health Unit. Minimum salary $2600, with allowance for previous experience and annual increments. Five day week, car allowance, Blue Cross and sick leave. Apply to Dr. R. G. Grenon, Director, Prescott and Russell Health Unit, Hawkesbury, Ontario. 4–6

Medical Director required for Kenora-Keewatin-Dryden Area Health Unit at Kenora, Ontario. Duties to commence as soon as possible. Minimum salary $7000 per annum. Unit is located in the Lake of the Woods vacation area. Replies may be submitted to D. T. McLeod, Secretary, Board of Health, Box 174, Kenora, Ontario.

Sanitary Inspector, qualified, required by Muskoka District Health Unit. Starting salary commensurate with experience. Car mileage, annual vacation, statutory holidays and cumulative sick leave. Pension plan under consideration. Apply to Dr. H. J. Lambert, Director, Muskoka District Health Unit, Bracebridge, Ontario.

Public Health Dentist with 5 years health unit experience desires to negotiate with any level of government in Canada or U.S.A. Box 27, Canadian Public Health Association, 150 College Street, Toronto 5, Ontario.